A New *Zamia* (Zamiaceae, Cycadales) from Eastern Chiapas, Mexico

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ABSTRACT. *Zamia lacandona*, a member of the *Z. splendens* species group, is described from the Selva Lacandona of eastern Chiapas, Mexico. It is distinguished from *Zamia splendens* Schutzman by its usually single arcuate leaf with falcate leaflets, erect short-peduncled megasporangiate strobili, decumbent microstrobili, and chromosome number of $2n = 16$, 17, or 18.

When *Zamia splendens* was described (Schutzman, 1984), collections from the Selva Lacandona of eastern Chiapas were recognized as somewhat more robust and possibly distinct, but were still ascribed to *Z. splendens* in the publication. During two subsequent botanical expeditions to southern Mexico, one in 1984 by the first author and a second one in 1993 by the second author and Terrence Walters and Charles Hubbuch of Fairchild Tropical Garden, specimens were collected in the vicinity of the Mayan ruins in the Selva Lacandona. Schutzman's (1984) earlier decision to include the eastern populations was conservative, because it was not known at that time whether a continuum in morphological features would bridge the morphological "gap" or discontinuity between the western and eastern Chiapan populations. Three significant facts clarified the question. First, specimens collected by the first author in the Lacandona forest produced cones for the first time in 1993, demonstrating differences in cone morphology and habit from *Z. splendens*. Second, plants of *Z. splendens* almost identical to the type specimen were discovered in nearby Tabasco during the above-mentioned 1993 expedition, extending the distribution range of *Z. splendens;* this greatly reduced the possibility that a morphological continuum of one large variable species existed. Third, the Lacandona plants have distinct cytological features distinguishing them from *Z. splendens*. Thus, it was decided that the Lacandona plants are, indeed, worthy of specific status. The large, normally solitary, robust-petioled leaf and relatively small caudex distinguish this species from its congeners in the wild, but in cultivation these features can change and should only be used to distinguish species in conjunction with other characteristics, such as the finely toothed leaflets and cone habit characters (discussed below).

Zamia lacandona Schutzman & Vovides, sp. nov. TYPE: Mexico. Chiapas: Selva Lacandona, July 1984 (male pl), *Schutzman 517* (holotype, FLAS; isotype, XAL). Figure 1a–h.

Haec species *Z. splendenti* Schutzman affinis sed apice strobilorum femineorum apiculato, erecto, foliolis novis xerampelinis et non roseis, et dentibus foliolorum tenuibus et non grossis differt.

Plants dioecious, 15–60 cm tall. Caudex subterranean, 17–40 cm long, 4.5–8 cm diam. Leaves usually 1, occasionally 2, depending upon condition of the plant and its environment, arcuate, sparingly pubescent upon emergence, 30–100 cm long, 34–80 cm wide; leaflets 7–12 pairs per leaf, opposite to subopposite on a single leaf, linear-lanceolate to slightly oblanceolate, proximal leaflets subfalcate, 13–42 cm long, 1.5–5 cm wide; apex acuminate, equal to unequal; margin subrevolute; marginal teeth in upper half of leaf, 1.0–1.25 mm; base attenuate, reddish brown when expanding, dark green when mature; articulation with rachis dark brown, 5–10 mm wide; petiole semi-terete, dark greenish brown covered with brown tomentum, spinose through approximately ¾ of its length from the base, 20–70 cm long, 10–20 mm diam.; spines terete, 0.8–4 mm long, 0.5–1 mm diam.; petiole base massive and almost encompassing entire apex of caudex, 1.5–3 cm wide; cataphylls chartaceous, elongate triangular, cone cataphylls narrow-triangular, pubescent, 2.8–6.3 cm long, 0.4–1.2 cm wide, leaf cataphylls deltoid with aristate apex, 2.2–3.4 cm long, base 2.3–3.8 cm wide. Microspo-

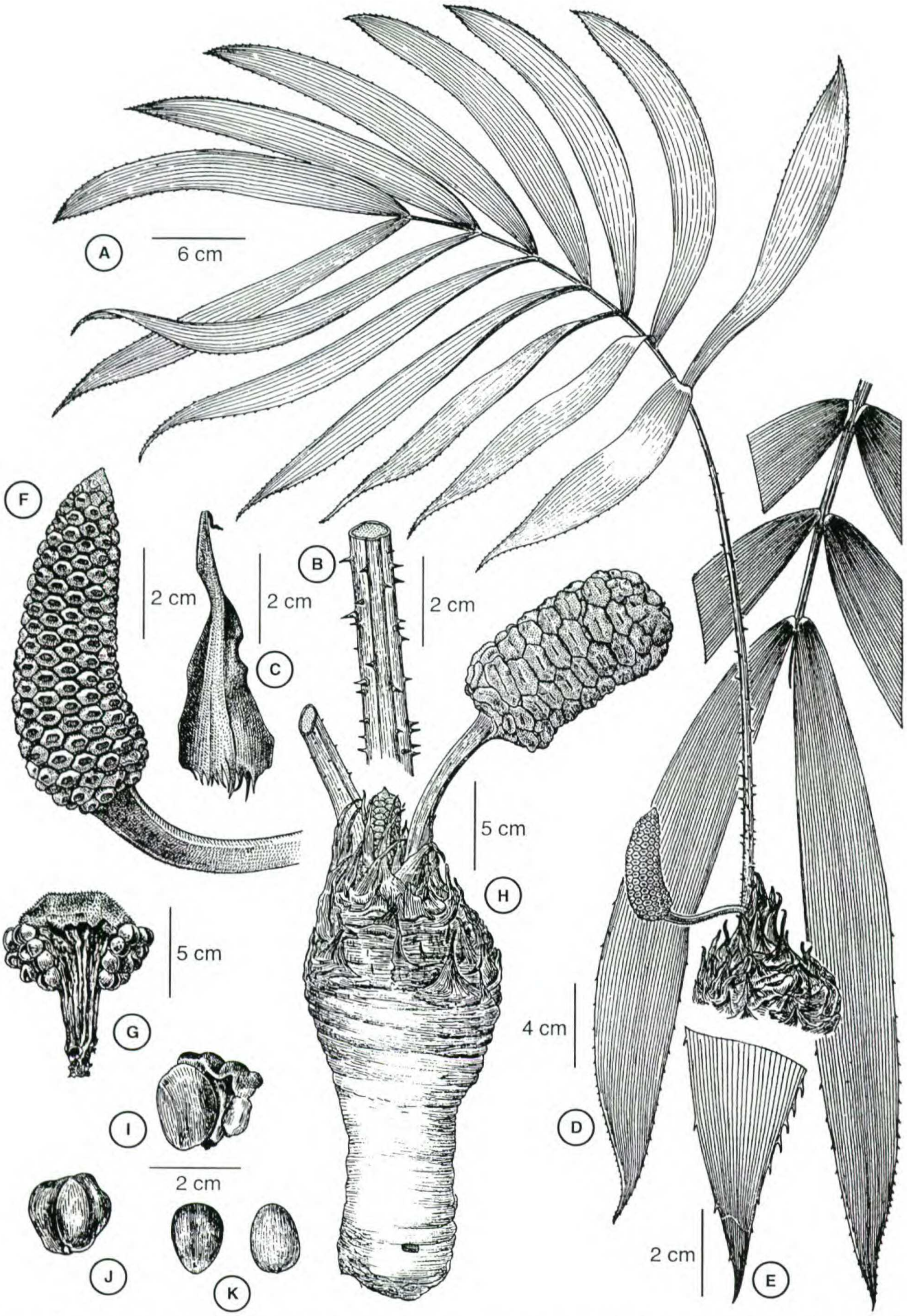

Figure 1. *Zamia lacandona* Schutzman & Vovides, sp. nov. —A. Habit. —B. Petiole detail. —C. Leaf cataphyll. —D. Leaf detail. —E. Leaf apex. —F. Microstrobilus. —G. Microsporophyll. —H. Caudex with megastrobilus. —I. Megasporophyll with attached seed. —J. Seed. —K. Seeds with sarcotesta removed.

rangiate strobili decumbent, cylindrical to conic, dark beige to light brown, apiculate, tomentulose, 6.5–7.4 cm long, 1.8–2.5 cm diam.; peduncle puberulent, 10–12 cm long, 0.5–0.8 cm diam.; microsporophylls cuneiform, puberulent, the distal ends truncate-hexagonal with a short hexagonal-truncate protuberance; microsporangia spheroidal, 14–18 (usually 16) per sporophyll, eight proximal to each margin of fertile area of sporophyll, aggregated into sori of two microsporangia each, dehiscing by longitudinal sutures. Megasporangiate strobilus cylindrical, barrel-shaped with an apiculate apex, chocolate brown with lighter beige hexagonal protruding facets, tomentulose, 12–14 cm long, 6–7 cm diam.; peduncle puberulent, 10–11 cm long, 0.8–1.0 cm diam., megasporophylls cuneiform-peltate, the distal ends hexagonal-truncate with a short hexagonal-truncate protuberance with horizontal groove, 1.7–2.0 cm long, 1.7–2.2 cm wide, short axis 1.1–1.6 cm tall; ovules two per megasporophyll. Seed irregularly angular, turning bright red at maturity, 1.6–1.8 cm long, 1.4–1.6 cm diam.; sclerotesta smooth, light brown. Chromosome number $2n = 16, 17, 18$.

Etymology. The species is named for the Lacandona rainforest ("Selva Lacandona") of eastern Chiapas, which itself is named for the Lacandona Indians of Mayan descent who inhabit the forest.

Distribution and ecology. The species is found in the Selva Lacandona in eastern Chiapas and adjacent areas, where it is found in primary forest, secondary successional regrowth such as abandoned cornfields, and continually disturbed areas such as roadsides, which are burned yearly to clear dead brush and tall grass. Regrowth of the plant is quite noticeable, as its large reddish brown new leaf makes it clearly distinguishable from other vegetation. The vegetation type of the undisturbed areas in which it is found is the "bosque tropical perennifolio" of Rzedowski (1978), or "selva alta perennifolia" of Miranda (1963). This species' subterranean caudex protects it from destruction by the slash-and-burn agricultural practices of subsistence farmers; arborescent species such as *Z. inermis* Vovides, Rees & Vázquez-Torres and *Z. soconuscensis* Schutzman, Vovides & Dehgan disappear entirely from cultivated areas because they cannot regenerate, making them all the more vulnerable to extinction. Subterranean species such as *Z. lacandona* are more apt to be decimated by commercial collection than by slash-and-burn agriculture, a fact that leads us to obscure the precise locality in this description.

Taxonomic relationships. The description of *Zamia lacandona* increases to five the number of closely related species in this group, which also includes *Z. splendens*, *Z. cremnophila* Vovides, Schutzman & Dehgan, *Z. purpurea* Vovides, Rees & Vázquez-Torres, and *Z. standleyi* Schutzman.

Emergent leaf color. Whereas *Zamia splendens* emerges bright pink or green, depending on the population examined (one or both colors may be found in a single population), *Z. purpurea* leaves are strictly deep reddish purple upon emergence. The leaves of *Z. standleyi* are brown, bronze, or light green when emerging. Those of *Z. lacandona* are reddish to purplish brown.

Leaf habit. Both *Zamia standleyi* and *Z. lacandona* possess arcuate leaves, while those of *Z. cremnophila* are pendent. *Zamia splendens* and *Z. purpurea* have relatively more erect leaves, with leaflets slightly arching.

Habit of strobili (Fig. 2). *Zamia lacandona* and *Z. standleyi* both have sexual dimorphism in the habit of micro- and megasporangiate strobili. The microsporangiate strobili are decumbent, while the megasporangiate strobili are erect. *Zamia splendens* and *Z. purpurea*, however, have decumbent micro- and megasporangiate strobili, and the mega- and microsporangiate strobili of *Z. cremnophila* are erect.

Color of strobili. The microsporangiate strobili of *Zamia lacandona* are beige to light brown, while those of *Z. standleyi* are darker brown, and the remaining three species have even darker, coffee-colored microsporangiate strobili. The megasporangiate strobili of *Z. lacandona* are two-toned, with darker protuberant hexagonal megasporophyll apices.

Caudex. The caudex of *Zamia lacandona* is distinctive because it is the smallest relative to leaf size of any other Mesoamerican species thus far examined. All the other species in this group, and the other more distantly related Mesoamerican species, appear to possess larger caudices while supporting the same amount of vegetative growth. This could be related to the rainforest habitat of *Z. lacandona.*

Leaflet shape and denticulation. The leaflet shapes and toothing of the five species are almost sufficient by themselves to distinguish the five members of this group of species (see Fig. 3). The major differences between the species are length/width ratio, marginal denticulation, and how falcate each species is. *Zamia cremnophila, Z. standleyi,* and *Z. lacandona* have falcate leaflets, while those of *Z. purpurea* and *Z. splendens* do not.

Other leaflet characteristics. *Zamia standleyi* is the only member of the group to possess longitudinal "folding" of the leaflets, and *Z. purpurea* is

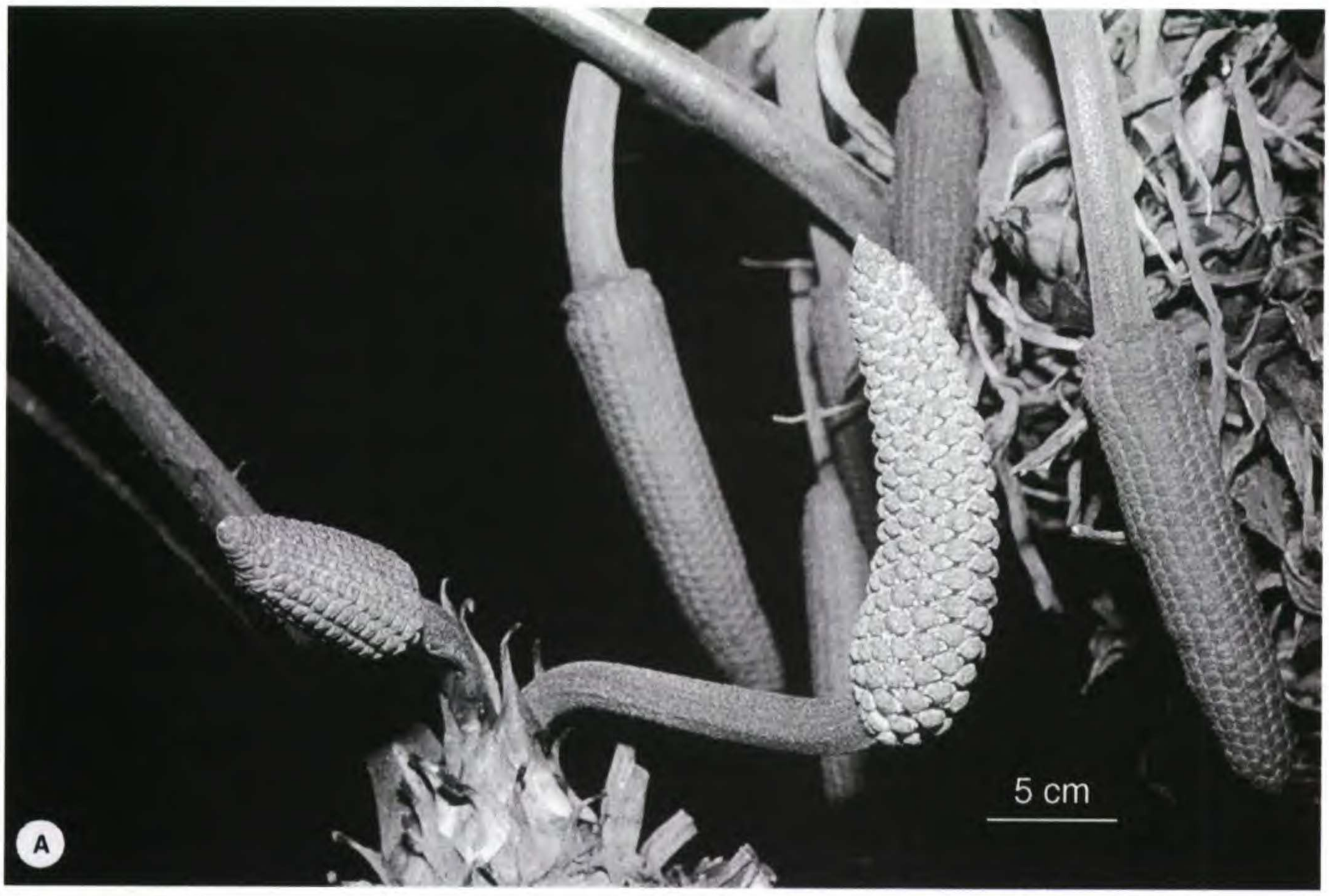

Figure 2. Comparison of strobilar habit and morphology between *Zamia lacandona* and *Z. splendens*. —A. Decumbent microstrobili of *Z. lacandona* vs. pendent microstrobili of *Z. splendens*. —B. Erect, short-peduncled megastrobilus of *Z. lacandona* vs. decumbent or pendent, long-peduncled megastrobili of *Z. splendens*. Photos courtesy of Loran Whitelock.

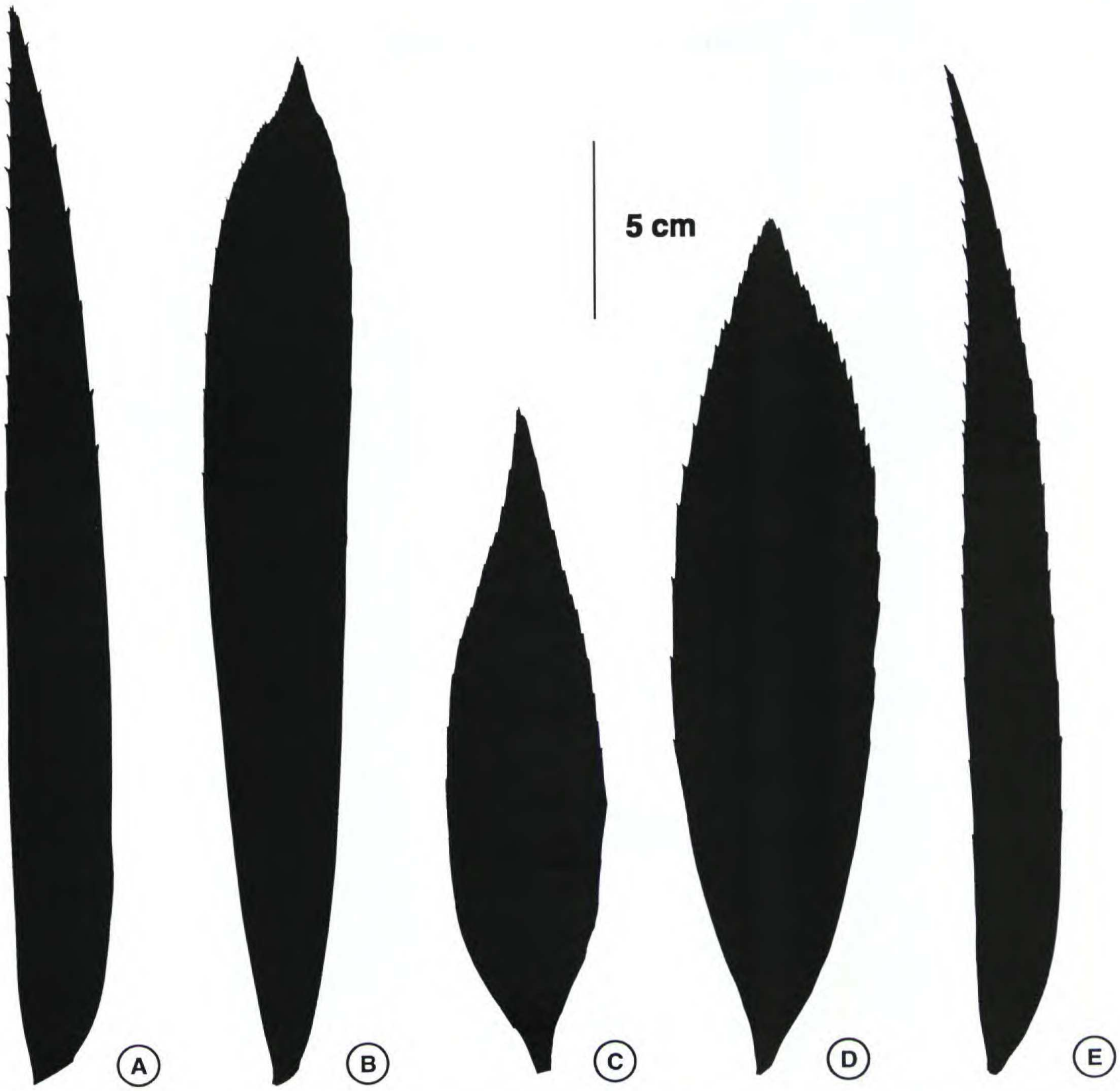

Figure 3. Comparison of leaflet shapes and sizes in the *Zamia splendens* species group. —A. *Z. cremnophila*. —B. *Z. lacandona*. —C. *Z. purpurea*. —D. *Z. splendens*. —E. *Z. standleyi*.

readily identifiable by its pronounced and often raised leaflet venation.

Chromosome number. With the exception of *Zamia lacandona* ($2n = 16$, 17, or 18), all known members of this species group have a diploid chromosome number of $2n = 16$.

Chromosomal studies. Root tip mitosis was studied according to the technique of Schutzman et al. (1988). Six individuals from three localities were examined, and herbarium vouchers were deposited at XAL. Counts of $2n = 16$, 17, and 18 were obtained. Camera lucida drawings were made from the best metaphase cells, where measurements were taken of the chromosomes and arranged in putative pairs to construct the idiograms. Classification of the chromosomes was according to Levan et al. (1964), modified by Schlarbaum and Tsuchiya (1984). Photomicrographs were taken on Kodak Plus-X 125 ASA film by a Zeiss Photomicroscope (Fomi III) fitted with a ×63 planapochromatic objective and phase contrast optics.

The new species differs in cytology with respect to *Zamia splendens* and *Z. cremnophila*, which are both $2n = 16$. Centric fissions and/or Robertsonian changes, as found in *Z. paucijuga* (Moretti & Sabato, 1984) and *Z. loddigesii* (Vovides & Olivares, 1996), appear to have occurred also in *Z. lacandona*, leading to at least three distinct cytotypes with somatic numbers of 16, 17, and 18. This presents a varying chromosome morphology with 1M +7m + 2msm +1sm + 1st + 4T, 1M + 5m + 3msm + 2sm + 6T, and 2M + 6m + 2sm + 1st

+ 7T, respectively. It appears that centric fissions occur on some of the larger mesocentric chromosomes giving rise to telocentrics with part of the centromere present; thus isochromosomes are formed. According to Lima-de-Faria (1983) these isochromosomes are stable and become easily incorporated into the normal complement. A break in a mesocentric chromosome with elongated kinetochore to form the cytotype $2n = 17$ can easily be envisioned, likewise for the $2n = 17$ cytotype to give rise to $2n = 18$.

Chromosome change is the manifestation of an evolutionary process that may be a response to changing environment. For example, a report on the present-day distribution of chromosome races of the shrew *Sorex araneus* in Great Britain interprets it as a product of colonizing radiations and retreats to refugia associated with climatic changes. In another case, it was found that the number of metacentric chromosomes of the grasshopper *Caledia captiva* increased on one side of a hybrid zone of chromosome races of this species during mesic years and that the number of acrocentrics increased during dry years (King, 1993).

Paratypes. MEXICO. **Chiapas:** Selva Lacandona, July 1984, *Schutzman 510-514* (XAL), *Schutzman 515-520* (XAL), *Schutzman 521-525* (XAL), June 1968, *J. Chavelas P., G. Alanís & M. Martínez ES-3015* (ENCB).

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